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(54) **METHODS OF CONNECTING CABLES WITH AN INSTALLATION TOOL**

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H01R 43/027	(2006.01)
H01R 4/50	(2006.01)

(52) **U.S. Cl.**

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CPC H01R 4/5083; H01R 43/0275; H01R 4/50; H01R 13/641; H01R 4/2412; H01R 13/193; H01R 4/489; Y10T 29/53213; Y10T 29/49208; Y10T 29/49826; Y10T 29/49945; Y10T 29/53839; Y10T 24/3969

USPC 29/720, 254, 744, 748, 868, 872

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,212,534	A	10/1965	Broske	
3,292,363	A *	12/1966	Wahl	B25B 27/0085 102/531

(Continued)

FOREIGN PATENT DOCUMENTS

EP	1458055	9/2004
WO	2009111144	9/2009

OTHER PUBLICATIONS

European Search Report issued in EP 12 27 5139 dated Jan. 4, 2013.

(Continued)

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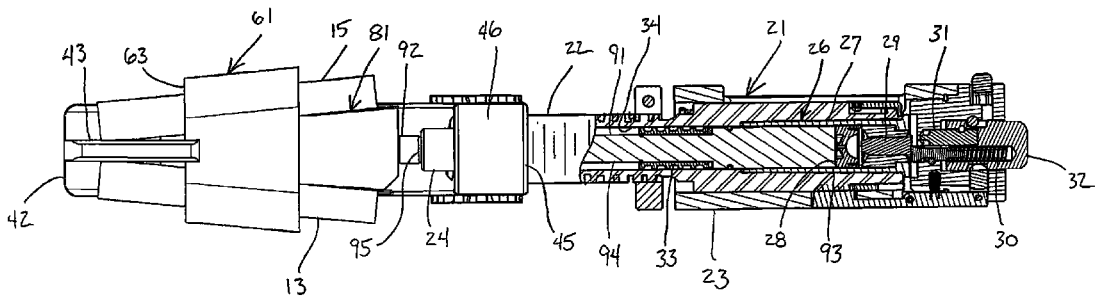
(57) **ABSTRACT**

A wedge connector assembly including an installation tool having a tool body and a frame connected to the tool body. A sleeve is received by the frame and a wedge is received by the sleeve. A firing mechanism is movably connected to the tool body. A movable ram extends from the tool body into the frame such that movement of the ram drives the wedge into the sleeve when the installation tool is fired. A piston is movably disposed in the tool body between the ram and the firing mechanism. The piston is moved when the firing mechanism is activated, thereby driving the wedge into the sleeve. An indicator disposed on the ram indicates when the installation tool is in a proper firing position to substantially prevent over-torquing the installation tool.

18 Claims, 3 Drawing Sheets



(52) **U.S. Cl.**
CPC *Y10T29/49201* (2015.01); *Y10T 29/53087* (2015.01); *Y10T 29/53213* (2015.01); *Y10T 29/53839* (2015.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,667,502	A		5/1987	Bush
4,722,189	A		2/1988	Center
RE33,098	E		10/1989	Center
4,905,603	A		3/1990	McBain
4,945,730	A	*	8/1990	Laney B25C 1/008 227/10
5,239,829	A		8/1993	Blake
6,996,987	B2		2/2006	Gregory
7,736,203	B2		6/2010	Copper
8,028,675	B2		10/2011	Gagliano
2007/0240301	A1		10/2007	Johnson et al.
2009/0223042	A1		9/2009	Chadbourne

OTHER PUBLICATIONS

AMPACT Taps, Stirrups and Application Tooling, May 18, 2010, XP055172850, Retrieved from the Internet: URL:http://www.te.com/us/en/industries/energy/PDF/409-2106.pdf [retrieved on Mar. 2, 2015].

European Examination Report, dated Mar. 10, 2015, for corresponding EP Patent Application No. 12275139.9.

* cited by examiner

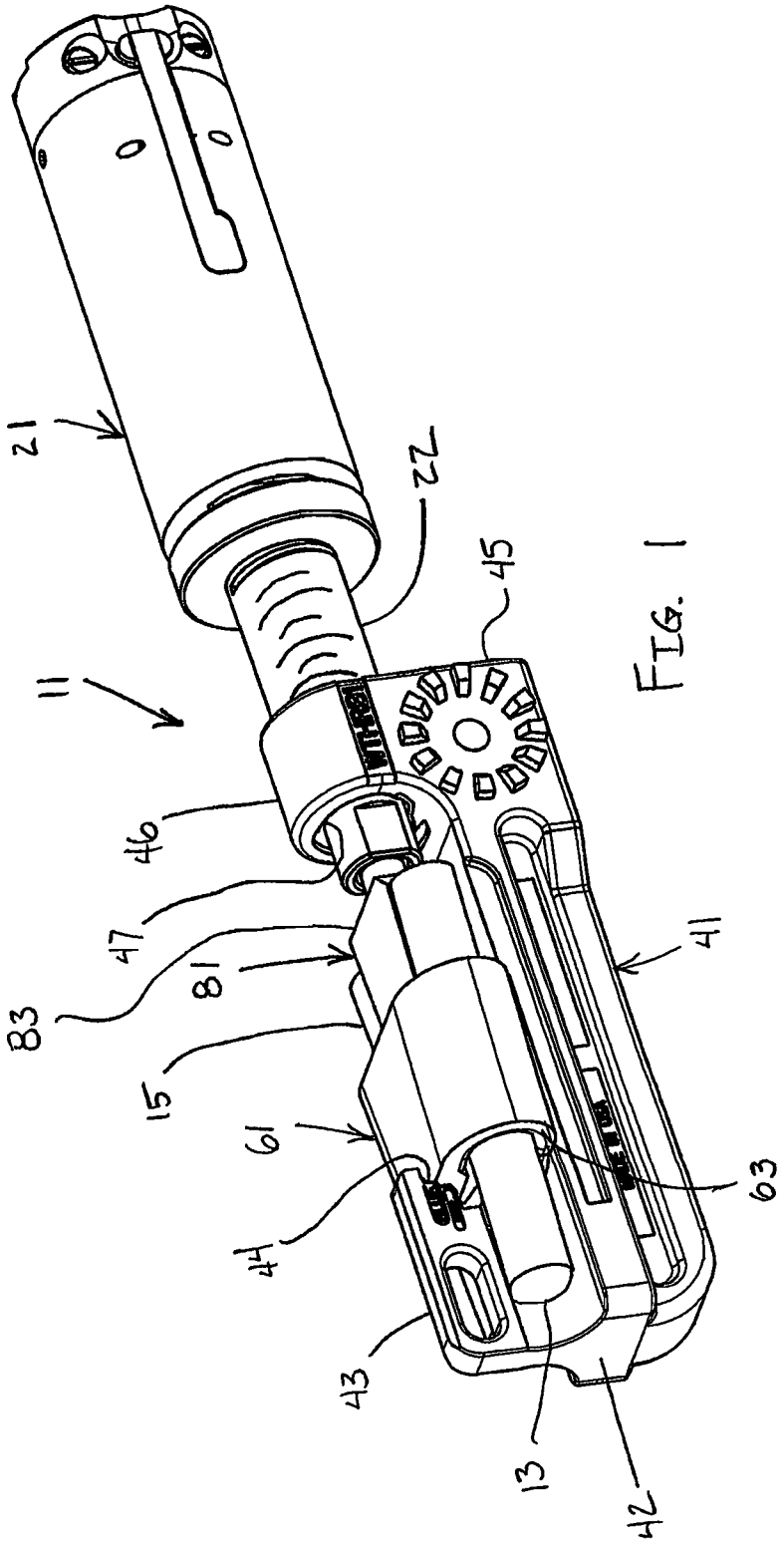


FIG. 1

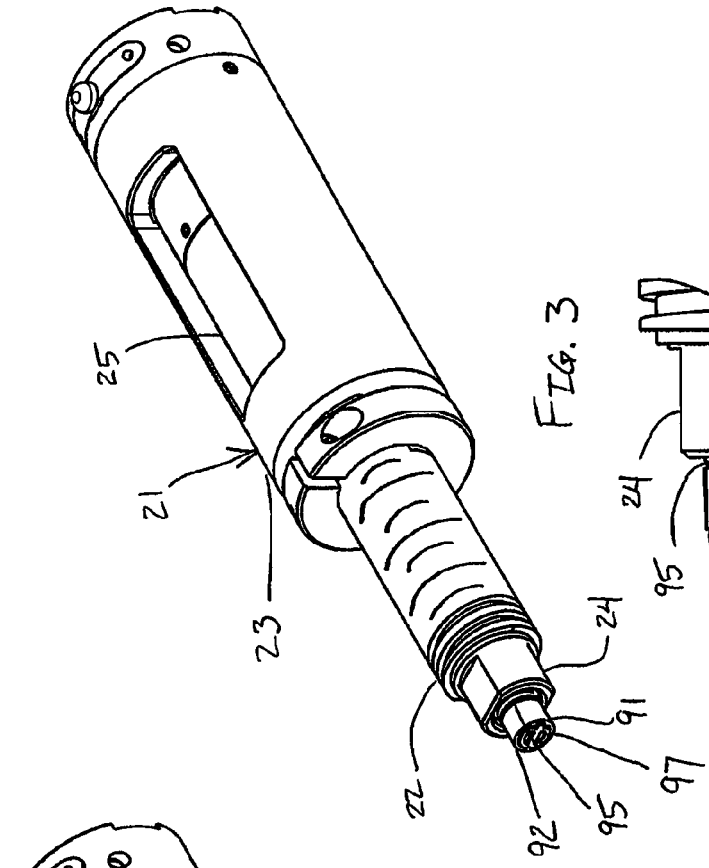


FIG. 3

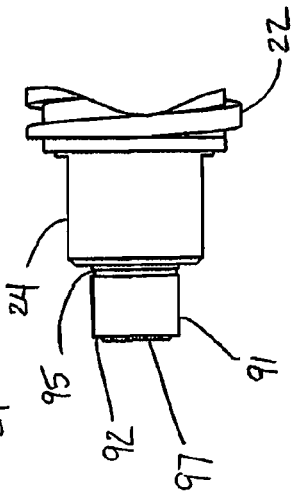


FIG. 5

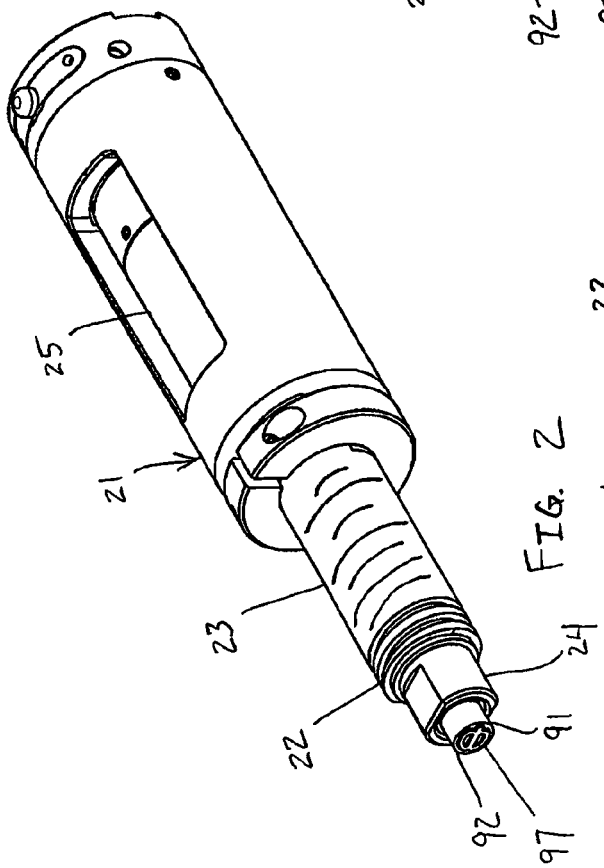


FIG. 2

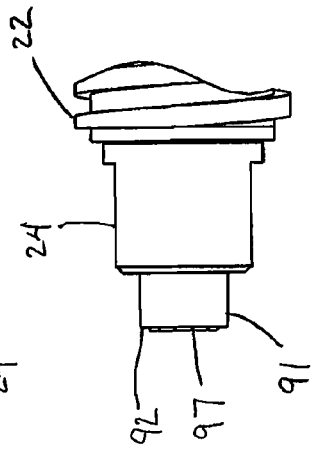


FIG. 4

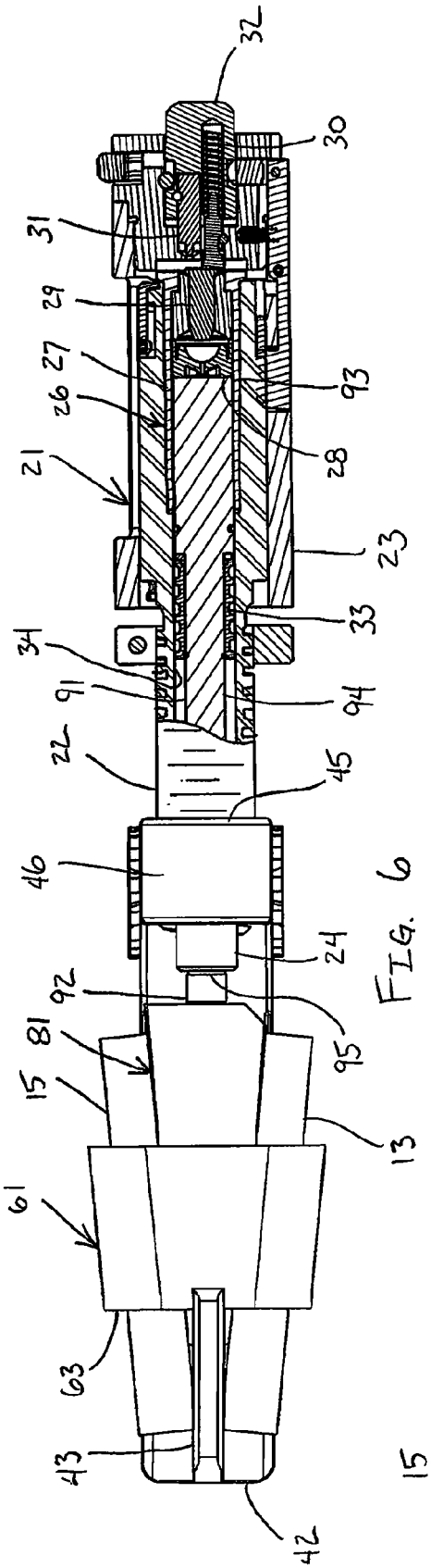

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FIG. 6

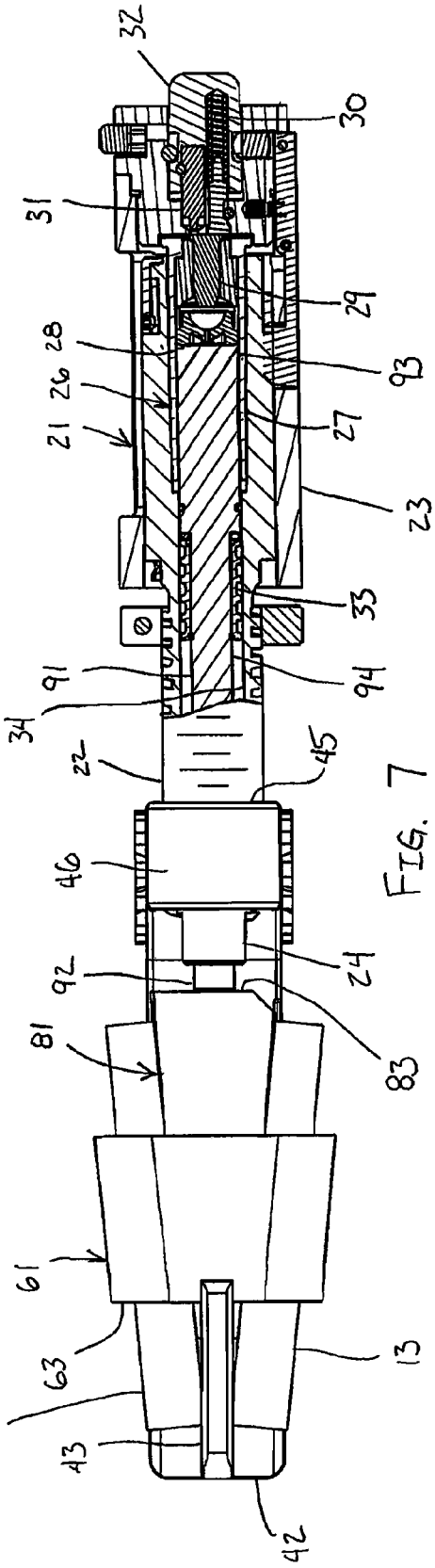
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FIG. 7

METHODS OF CONNECTING CABLES WITH AN INSTALLATION TOOL

CROSS REFERENCE TO RELATED APPLICATION

This application is a divisional application of Ser. No. 13/607,989, filed Sep. 10, 2012, which claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Application Ser. No. 61/573,148, filed Sep. 14, 2011, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates generally to a limit indicator for a ram of a wedge connector. Still more particularly, the present invention relates to a limit indicator for preventing over-torquing of a ram of a wedge connector prior to installation.

BACKGROUND OF THE INVENTION

A wedge connector includes an installation tool that drives a wedge into a sleeve to electrically and mechanically connect two cables. The two cables are passed through the sleeve on opposite sides of the wedge. Conventional installation tools use a powder cartridge to obtain a sufficient force to drive the wedge into the sleeve to securely retain the cables between the wedge and the sleeve.

In a non-firing position, a spring spaces a firing pin from a load cell in the installation tool. Torque is applied to the installation tool to compress the spring and move the load cell adjacent to the firing pin, thereby putting the installation tool in a firing position.

However, problems have occurred in operating conventional installation tools in removing the tools from installed wedges. When readying the installation tool for firing, users can over-torque the installation tool when compressing the spring. The over-torquing causes the ram to start to push the wedge into the sleeve. When the installation tool is fired, gas is generated in the tool housing to drive the wedge into the sleeve. Over-torquing the installation tool causes the ram to start to push the wedge into the sleeve such that some of the generated gas remains in the tool housing after the wedge has been driven by the ram. The gas remaining in the tool housing keeps a piston in engagement with the ram, thereby making removal of the installation tool difficult. Accordingly, a need has been discovered for a wedge connector in which over-torquing of the installation tool is substantially prevented.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an installation tool that prevents over-torquing of an installation tool.

Another object of the present invention is to provide an installation tool in which the installation tool is easily removed from the wedge after installation.

In accordance with an aspect of the present invention, a wedge connector assembly includes an installation tool having a tool body and a frame connected to the tool body. A sleeve is received by the frame and a wedge is received by the sleeve. A firing mechanism is movably connected to the tool body. A movable ram extends from the tool body into the frame such that movement of the ram drives the wedge into the sleeve when the installation tool is fired. A piston is movably disposed in the tool body between the ram and the firing mechanism. The piston is moved when the firing mechanism is activated, thereby driving the wedge into the sleeve. An indicator disposed on the ram indicates when the installation tool is in a proper firing position to substantially prevent over-torquing the installation tool.

In accordance with another aspect of the present invention, a method is provided of connecting cables with an installation tool. A tool body is rotated to put the installation tool in a firing position. The rotation of the tool body is stopped when indicated by an indicator to substantially prevent over-torquing the installation tool. A firing mechanism is activated to drive a wedge into a sleeve to secure the cables between the wedge and the sleeve.

Objects, advantages, and salient features of the invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses an exemplary embodiment of the present invention.

As used in this application, the terms "front," "rear," "upper," "lower," "upwardly," "downwardly," and other orientational descriptors are intended to facilitate the description of an exemplary embodiment of the present invention, and are not intended to limit the structure thereof to any particular position or orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

The above benefits and other advantages of the various embodiments of the present invention will be more apparent from the following detailed description of exemplary embodiments of the present invention and from the accompanying drawing figures, in which:

FIG. **1** is a perspective view of a wedge connector in accordance with an exemplary embodiment of the present invention;

FIG. **2** is a perspective view of an installation tool in a firing position;

FIG. **3** is a perspective view of an installation tool in a non-firing position;

FIG. **4** is a partial side elevational view of a ram of the installation tool of FIG. **2**;

FIG. **5** is a partial side elevational view of a ram of the installation tool of FIG. **3**;

FIG. **6** is a top plan view in partial cross section of the wedge connector of FIG. **1** in which the installation tool is in a non-firing position; and

FIG. **7** is a top plan view in partial cross section of the wedge connector of FIG. **1** in which the installation tool is in a firing position.

Throughout the drawings, like reference numerals will be understood to refer to like parts, components and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT

The wedge connector **11** includes an installation tool **21**, a frame **41**, a sleeve **61** and a wedge **81**, as shown in FIGS. **1**, **6** and **7**. The installation tool **21** drives the wedge **81** into the sleeve **61** to securely retain wires, or conductors, **13** and **15** between the wedge **81** and the sleeve **61**, thereby electrically connecting the wires **13** and **15**.

The frame **41** has a front end **42** forming an anvil section **43**. The anvil section **43** includes a sleeve receiving portion **44** for receiving a front end **63** of a sleeve **61**. A rear end **45** of the frame **41** forms a tool supporting portion **46** having a threaded bore **47** for receiving a threaded portion **22** of a tool body **23**. The threaded portion **22** of the tool body **23** is threaded through the bore **47** of the frame **41** to support the installation

tool **21** and align a ram **91** of the installation tool **21** with a longitudinal axis of the frame **41**.

The tool body **23** includes an end bearing **24** connected to the threaded portion **22**, as shown in FIGS. **2-5**. A firing mechanism is connected to the tool body **23** to activate the installation tool **21** when in the firing position. A chamber **25** in the tool body **23** receives a booster assembly **26**, as shown in FIGS. **6** and **7**. The booster assembly **26** includes a sleeve **27**, a piston **28** and a power cell **29**, such as a cartridge, as shown in FIGS. **6** and **7**. The piston **28** and power cell **29** are disposed within the sleeve **27**. The spring member **30** biases the firing pin **31** away from the power cell **29** to prevent accidentally exploding the power cell, as shown in FIG. **6**.

The ram **91** is movably disposed in the tool body **23**, as shown in FIGS. **6** and **7**. A first end **92** of the ram **91** extends externally of the end bearing **24**. A second end **93** of the ram **91** is disposed within the tool body **23** and abuts the piston **28** within the sleeve **27** of the booster assembly **26**. An inner bearing **33** is disposed on an outer surface **94** of the ram **91** to permit axial movement of the ram **91** through a bore **34** of the tool body **23**. An identifier **97**, such as a trademarked logo, can be disposed on the first end **92** of the ram **91**. The identifier **97** is imprinted on the wedge **81** when the wedge is driven into the sleeve **61** by the ram **91**.

A limit indicator **95** is disposed on the outer surface **94** of the ram **91** proximal the first end **92**, as shown in FIGS. **3**, **5** and **6**. Installation tool **21**, except for the limit indicator **95**, is conventional and is disclosed further in the English portion of the 2011 Burndy Safety Operating & Maintenance Instructions for the Burndy WEJTAP System, the entire disclosure of which is hereby incorporated by reference (available from the Burndy Tool Service Center in Littleton, NH). The tool body **23** is rotated to put the installation tool **21** in a firing position, as shown in FIG. **7**. The end bearing **24** rotates with the tool body **23**. When the end bearing **24** is moved over the limit indictor **95** such that the limit indicator **95** is no longer visible, the installation tool **21** is in the firing position. Accordingly, the user knows to stop rotating the tool body **23** when the limit indicator **95** is no longer visible, as shown in FIG. **7**, thereby substantially preventing over-torquing. The limit indicator **95** can be any type of indicator on the ram **91** that is visible to the user. For example, the limit indicator **95** can be, but is not limited to, a line painted on an outer surface of the ram **91**, a groove formed in the outer surface of the ram **91**, a line painted in a groove formed in the outer surface of the ram **91**, or an indicator ring disposed on an outer surface of the ram **91**. The limit indicator **95** can be a permanent indicator or a temporary indicator that wears off over time as the user becomes more familiar with the installation tool **21**.

In a non-firing position, as shown in FIGS. **3**, **5** and **6**, the spring **30** biases the firing pin **31** away from the power cell **29**, thereby substantially preventing accidentally exploding the power cell. The limit indicator **95** on the ram **91** is visible when the installation tool is in a non-firing position. The first end **92** of the ram **91** contacts the first end **83** of the wedge **81**.

To put the installation tool **21** in a firing position, as shown in FIGS. **2**, **4** and **7**, the tool body **23** is rotated to overcome the biasing force of the compression spring **30**. The tool body **23** is rotated resulting in axial movement of the tool body **23**, including the end bearing **24**. The inner bearing **33** allows the tool body **23** to be rotated about the ram **91** without moving the ram. Axial movement of the tool body **23** results in the spring **30** being compressed and the firing pin **31** being moved to a position abutting the power cell **29**. The axial movement of the tool body **23** also results in axial movement of the end bearing **24**, which covers the limit indicator **95**. When the limit indicator **95** is no longer visible, the proper torque is obtained for firing the installation tool **21**. The user stops rotating the tool body **23**, thereby substantially preventing over-torquing of the installation tool **21**. Accordingly, by substantially preventing over-torquing, the user is prevented from beginning to insert the wedge **81** into the sleeve **61**.

To fire the installation tool **21**, a hammer, or other suitable tool, is used to strike the firing button **32**. The inward axial movement (to the left in FIG. **7**) of the firing button **32** causes axial movement of the firing pin **31**, which penetrates the power cell **29** and causes the power cell **29** to explode. The gas generated by the explosion of the power cell **29** moves the piston **28** axially causing the piston to strike the ram **91**, which is driven axially through the bore **34** of the tool body **23**. The first end **92** of the ram **91** pushes the wedge **81** further into the sleeve **61**, thereby mechanically securing the cables **13** and **15** between the wedge **81** and the sleeve **61**. When the piston **28** and ram **91** stop moving, the piston **28** welds to the inner wall of the sleeve **27**, thereby storing the generated gas pressure behind the piston. When the installation tool **21** is turned off, the stored generated gas vents through the piston **28** and down through the bore **34**. The gas exits the tool **21** between the ram **91** and the end bearing **24**.

When the installation tool **21** is not over-torqued, the generated gases are expelled from the tool body **23**. The tool body **23** can then be rotated away from the wedge **81** creating a gap between the piston **28** and the second end **93** of the ram **91**, such that the ram **91** can be moved away from the wedge **81**. The installation tool **21**, including the frame **41**, can be removed from the sleeve **61** and wedge **81**. The used booster assembly **26** can then be removed from the tool body **23** and replaced with a new booster assembly to electrically and mechanically connect two other cables with another sleeve **61** and wedge **81**.

When a user over-torques the tool body **23**, the power cell **29** and piston **28** begin to push the second end **93** of the ram **91** such that the ram **91** starts pushing the wedge **81** into the sleeve **61**. Thus, when the installation tool **21** is fired, the wedge **81** does not need to be pushed as far into the sleeve **61** because the wedge **81** has already been partially pushed into the sleeve **61** by over-torquing the tool body **23**. Thus, not all of the gas generated by the exploding power cell **29** is used to drive the ram **91**. The remaining gas makes axial movement of the ram **91** away from the wedge **81** (to the right in FIG. **7**) extremely difficult after the wedge has been installed, thereby making removal of the installation tool **21** from the assembled sleeve **61** and wedge **81** extremely difficult. By providing the ram **91** with a limit indicator **95** to prevent over-torquing the installation tool **21**, this problem is substantially prevented and the installation tool **21** can be easily removed following use.

The foregoing embodiment and advantages are merely exemplary and are not to be construed as limiting the scope of the present invention. The description of an exemplary embodiment of the present invention is intended to be illustrative, and not to limit the scope of the present invention. Various modifications, alternatives and variations will be apparent to those of ordinary skill in the art, and are intended to fall within the scope of the invention as defined in the appended claims and their equivalents.

What is claimed is:

1. A method of connecting cables with an installation tool, comprising the steps of

positioning a sleeve on the cables;

rotating a tool body to put the installation tool in a firing position;

stopping rotation of the tool body when indicated by an indicator on the installation tool to substantially prevent over-torquing the installation tool; and

activating a firing mechanism to drive a wedge into the sleeve to secure the cables between the wedge and the sleeve.

2. The method of connecting cables with an installation tool according to claim **1**, wherein

the indicator is positioned to provide a visual indication of the tool body in the firing position.

3. The method of connecting cables with an installation tool according to claim **1**, further comprising

venting gas generated by activating the firing mechanism to facilitate removing the tool body from the wedge and the sleeve.

4. The method of connecting cables with an installation tool according to claim **1**, further comprising

disposing the indicator on a ram of the installation tool about which the tool body is rotated to the firing position.

5. The method of connecting cables with an installation tool according to claim **4**, further comprising

stopping rotation of the tool body when the indicator is no longer visible.

6. The method of claim **1**, wherein

the installation tool has a ram actuated by the firing mechanism, and where the tool body is rotatably mounted on the ram, said method comprising

rotating the tool body relative to the ram to the firing position identified by the indicator without over-torquing the tool body relative to the ram.

7. The method of claim **1**, wherein

the installation tool has a ram, and the tool body is rotatable relative to the ram between a non-firing position and the firing position, said method comprising

rotating the tool body relative to the ram to the firing position.

8. The method of claim **7**, wherein

the indicator is positioned to indicate when the tool body is rotated to the firing position.

9. The method of claim **8**, wherein

the indicator is on the ram, said method comprising

rotating the tool body until the indicator is not visible indicating that the tool body is in the firing position.

10. A method of connecting cables together with an installation tool, said method comprising the steps of

positioning a sleeve and the installation tool on the cables, said installation tool having a tool body, a ram, a firing mechanism, and a frame connected to the tool body;

rotating the tool body relative to the ram to position the installation tool in a firing position; and

stopping the rotation of the tool body when an indicator on said installation tool identifies a predetermined firing position without over-torquing the tool body with respect to the ram; and

activating a firing mechanism to drive a wedge into said sleeve to secure the cables between the wedge and the sleeve.

11. The method of claim **10**, wherein

the indicator is on the ram, and where said method further comprises

rotating the tool body relative to the ram to orient the tool body relative to the indicator in the firing position.

12. The method of claim **11**, wherein

the tool body is threaded to the frame, said method comprising

rotating the tool body relative to the frame and the ram until the indicator is not visible without over-torquing the tool body.

13. The method of claim **11**, wherein

the indicator is positioned on the ram to provide a visual indication of the tool body relative to the ram.

14. The method of claim **13**, wherein

the indicator is on an outer surface of a proximal end of the ram, the method comprising

rotating the tool body relative to the frame until an end bearing of the tool body covers the indicator.

15. The method of claim **10**, wherein

the firing mechanism is connected to the tool body, a wedge is received in said sleeve, and a piston is positioned in said tool body between said ram and firing mechanism, said piston driving said wedge into said sleeve when said firing mechanism is actuated.

16. A method of connecting cables, comprising the steps of

positioning a sleeve on the cables and a wedge between the cables within the sleeve,

positioning an installation tool on the sleeve, said installation tool having a tool body, a frame connected to the tool body, a firing mechanism, a movable ram extending from the tool body into the frame, and an indicator to indicate a firing position of said tool body relative to the ram and frame; and

rotating the tool body relative to the ram to position the tool body in the firing position, without over-torquing, and actuating said firing mechanism.

17. The method of claim **16**, wherein

the installation tool has a movable piston disposed in the tool body between the ram and the firing mechanism, said piston being moved when the firing mechanism is activated to drive the wedge into the sleeve.

18. The method of claim **17**, wherein

the indicator is a visual indicator on the outer surface of a proximal end of the ram, the method comprising

rotating the tool body relative to the frame and the ram until an end bearing of the tool body covers the indicator.

* * * * *